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Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

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FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

In the Matter of)

Federal-State Joint Board on Universal Service)

CC Docket No. 96-45

Forward-Looking Mechanism for High Cost
Support for Non-Rural LECs)

CC Docket No. 97-160

COMMENTS OF NORTHERN TELECOM, INC.

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SUMMARY

In these comments, Nortel addresses an issue raised in the *Further Notice* -- the inclusion of fixed wireless access ("FWA") services into the forward-looking model(s) for estimating the cost of providing universal service support. Nortel's comments provide information demonstrating that the previous cost estimates (of \$10,000 per line) are too high. In addition, Nortel has offered to work with the Commission and the model proponents so that FWA services are accurately reflected in the model(s).

Nortel believes such modeling will establish that, for many different types of situations, wireless access service in the form of FWA will meet the standard for forward-looking economic costs to be reflected in the model(s): "the least cost, most efficient, and reasonable technology currently available for purchase with all inputs valued at current prices." Nortel's beliefs with regard to this matter are grounded in its extensive experience in deploying FWA systems in many countries outside the United States, where FWA is an efficient, effective and robust solution to deploying or upgrading a communications infrastructure.

In order for these beneficial services to become available, however, it will be necessary for the Commission to ensure that applicable spectrum and capacity can be placed in the hands of the relevant service providers under appropriate licensing terms and conditions. Such an allocation would well serve the public interest.

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_____)	

COMMENTS OF NORTHERN TELECOM, INC.

Northern Telecom Inc. ("Nortel") hereby responds to some of the issues raised in the *Further Notice* addressing the costing models to be used in determining high cost support for non-rural local exchange carriers.^{1/} As discussed in greater detail below, Nortel believes that the forward-looking models for estimating the economic cost of providing universal service support should incorporate fixed wireless access ("FWA") technologies. Nortel commits to working with the Commission and the model proponents to modify the different models (or composite model) so that such wireless offerings are properly included in the model design.

^{1/} *Federal-State Joint Board on Universal Service; Forward Looking Mechanism for High Cost Support for Non-Rural LECs*, CC Docket Nos. 96-45 and 97-160, FCC 97-256, released July 18, 1997 (cited herein as "*Further Notice*").

Nortel believes such modeling will establish that, for many different types of situations, wireless access service in the form of FWA will meet the standard for forward-looking economic costs to be reflected in the model(s): "the least cost, most efficient, and reasonable technology currently available for purchase with all inputs valued at current prices.^{2/}" In order for these beneficial services to become available, however, it will be necessary for the Commission to ensure that applicable spectrum and capacity can be placed in the hands of the relevant service providers under appropriate licensing terms and conditions. Based on its extensive experiences to date outside the United States, Nortel is prepared to address these parameters to assist the Commission.

Nortel is keenly interested in universal service and its impact on the telecommunications network.^{3/} It is the leading global supplier, in more than 100 countries, of digital telecommunications systems to businesses, universities, local, state and federal governments, the telecommunications industry, and other institutions. The company employs more than 25,000 people in the United States in manufacturing plants, research and development centers, and in marketing, sales and service offices across the country. Nortel appreciates the increased value of the telecommunications infrastructure when everyone has access to a robust network.

^{2/} *Further Notice* at n. 38.

^{3/} Nortel has participated in earlier phases of this proceeding. *See, e.g.*, Comments of Northern Telecom, CC Docket No. 96-45 (filed May 7, 1996); Reply Comments of Northern Telecom, CC Docket No. 96-45, (filed December 19, 1996).

Nortel is also heavily involved in the development of wireless solutions to meeting today's communications needs. Nortel's Wireless Networks division is one of three major network businesses based in Richardson, Texas, where Nortel employs more than 5,000 people. Nearly 2,000 of those employees are in Wireless Networks, which addresses global growth markets for digital cellular, PCS, and wireless access. Nortel is also already deploying FWA technologies in a number of countries, and is thus highly interested in the potential impact of FWA on the Commission's universal service modeling proceeding.

Nortel is particularly well qualified to address these modeling issues, insofar as it manufactures both wireline and wireless communications systems. As a major supplier of switching, transport, access and wireless systems (including all traditional and emerging technologies) to most sectors of the telecommunications industry, Nortel is well-positioned to understand all aspects of the evolution, planning and deployment puzzle for the regulated, unregulated, embedded and competitive players in the market. Nortel is able to convert technologies and products into effective solutions and differentiated service platforms without undue bias, and render objective advice to operators, investors, planners (and regulators) trying to steer their way through the complex array of options and alternatives.

I. THE MODEL(S) SHOULD BE REFINED TO INCORPORATE
FIXED WIRELESS ACCESS TECHNOLOGIES

Nortel has carefully studied the various demands and technologies, and believes that FWA alternatives should be included in efforts to model the increasingly complex telecommunications access infrastructure. In the *Further Notice*, the Commission recognized that the two models under active consideration (the Benchmark Cost Proxy Model ("BCPM") and the Hatfield Model version 3.1 ("Hatfield Model")) took divergent approaches to the incorporation of wireless alternatives. The Hatfield Model did not assume that wireless services could be less expensive than wireline loop, and so did not incorporate a wireless component into its model.^{4/} The BCPM, in contrast, reflects wireless alternatives to the extent that it assumes an efficient carrier would substitute wireless service in circumstances where wireline loop investment would exceed \$10,000 per customer.^{5/}

Nortel has made significant efforts in attempting to assess the economics of substituting wireless technologies for wireline (or "wireline equivalent") access networks, with commercial deployments in more than twenty networks worldwide using a number of wireless standards and solutions, and a further twenty operators carrying out pre-deployment evaluations. As noted in the *Further Notice* (at Paragraph 97), Nortel indicated in its earlier comments that the estimate in the model of a cost for FWA of \$10,000 per line is excessive

^{4/} *Further Notice* at ¶ 96.

^{5/} *Further Notice* at ¶ 96.

because of rapidly falling prices.^{6/} Other commentators also addressed this issue regarding the cost of wireless access for purposes of incorporation into the model(s).^{7/}

In these comments on the *Further Notice*, Nortel re-confirms its original comments, and provides representative examples or ranges of the costs of FWA. Also included with these comments (at Attachment A) is a summary of the major cost elements involved in adding or incorporating FWA solutions in the universal service economic models. In a previous submission Nortel provided an example of a North American case study covering 500 communities with a large number of underserved (*e.g.*, 2- and 4-party line subscribers) and unserved demand, for residential, business and community/public service applications.^{8/} In the thirteen months since the comments were submitted, Nortel and the operator concerned, with the active support and encouragement of the regulator, have completed initial customer trials and are now deploying a pilot commercial service for approximately 500 subscribers with the expectation of a final spectrum policy within the next few months and larger scale deployment during 1998-99.^{9/} These pilot deployments are confirming the earlier projections of actual cost per line vis-a-vis the fiber/copper alternatives, and also confirm that service can be deployed more rapidly across a wider number of communities.

^{6/} See generally, Nortel Comments in CC Docket No. 96-45, December 19, 1996, at pp. 5-6.

^{7/} *Further Notice* at ¶ 97.

^{8/} See Nortel Comments in RM-8837, filed August 12, 1996, at pp. 19-20.

^{9/} For a description of this project, see Bell Canada's web site at www.Bell.ca/bell/eng/library/nr\97\s97e29.htm.

Through the deployment of FWA technologies, the customers concerned will enjoy full "wireline equivalent" service and quality, including full speed fax and modem data, with future roll-out of ISDN and other data services.

Nortel's FWA deployments and cost models cover a range of urban, suburban and rural applications involving ILEC, CLEC and CATV operator environments. Nortel's studies show that the initial fixed cost per home covered can be between five dollars (\$5) per home covered (for roughly 680 homes per square mile) to one thousand dollars (\$1,000) per home covered (for a density of one home per square mile). The variable cost per line connected (*i.e.*, deferred until the time of connection and revenue generation) can typically vary between \$400 per line connected and \$1500 per line connected. There may also be certain additional costs for extreme tower/site and civil works or complex/lengthy backhaul segments and signalling convertors, but even then the total cost per connected line is unlikely to exceed \$5,000 per line connected (except in VERY low density isolated situations).

II. **NORTEL URGES THE COMMISSION TO ADDRESS SPECTRUM ISSUES
FOR FIXED WIRELESS ACCESS TECHNOLOGIES SO THAT THESE
BENEFICIAL SERVICE ACTUALLY CAN BE MADE MORE WIDELY
AVAILABLE TO CUSTOMERS IN THE UNITED STATES**

Nortel believes that for regulatory purposes there are two forms of Fixed Wireless Access technology and spectrum -- CMRS and non-CMRS. The engineering models for both systems are essentially the same, and both can meet the minimum service requirements as defined by the Commission in the Universal Service Order. However, these two categories

have somewhat different attributes and characteristics, which are important to providing satisfactory service to residential and small business customers.

CMRS Fixed Wireless Access:

The CMRS technologies and spectrum (*e.g.*, Cellular and PCS) are geographically available across the United States, but not necessarily to the Universal Service operator or in a form that can suit a (fixed) Universal Service provider. CMRS spectrum, technologies and standardized air interfaces are optimized for mobility applications and voice service, with pay-per-minute tariffing, services provided by mobility switches and support systems and variable grades of service depending on ad hoc user density and demands. CMRS-based FWA can be implemented by simply adding fixed "line access units" ("LAUs") or special RF telephone sets on an incremental basis to an existing mobile infrastructure. Mobile operators may have to make a trade-off in their business case between offering PSTN-like fixed service vis-a-vis the higher value mobility offerings.

If a fixed "Universal Service" operator (without CMRS licenses) wishes to use a CMRS technology rather than fiber and copper, he must either resell the cellular or PCS service (and presumably absorb the tariff differences) or negotiate to buy/lease dedicated spectrum from the CMRS spectrum owner, which might not be readily available or available for a long enough time to fulfill the Universal Service customer expectations. This combination of factors tends to limit the use of CMRS-based FWA as a "mainstream" technology by fixed operators. Nortel therefore urges the Commission to examine rules for

encouraging CMRS and non-CMRS operators in rural communities to specifically cooperate in the mutual assignment and planning of CMRS spectrum so that CMRS based FWA technologies can become part of the mainstream Universal Service planning toolkit of fixed and mobile access network planners, improving the services and choices offered to rural communities and reducing the incremental burden of Universal Service subsidies compared to fiber or copper deployments.

Non-CMRS Fixed Wireless Access:

Although CMRS spectrum and technologies can meet the minimum service and quality requirements stipulated by the Commission for Universal Service,^{10/} they are unable to meet all of the requirements of residential and small business customers in the community.

As a result, Non-CMRS-based FWA could provide a more optimal solution for personal and residential service in geographic areas which, in addition to voice, require higher bandwidth or more predictable Internet access, fax, data and ISDN-type services which otherwise require the use of fiber or copper.

The rest of the World is currently solving this problem by also adopting the latest generation of "Wireline Equivalent" Fixed Wireless Access technologies.^{11/} While this new

^{10/} *Further Notice* at ¶ 12.

^{11/} *See generally*, Nortel Comments in RM-8837, filed August 12, 1996 at pp. 10-15 and Attachment B; Nortel Comments in CC Docket No. 96-45, filed December 19, 1996, at pp. 3-4.

technology is currently available as evidenced by deployment in many countries, it can only be offered in the United States if there is suitable spectrum allocated for that purpose.

CMRS wireless services and spectrum are inadequate to meet these critical needs on a mainstream market basis, and it is not viable to develop these products only for the rural application.^{12/} Thus, Nortel renews its request that the Commission allocate spectrum for wireline-equivalent FWA services. In particular, Nortel would like to work with the Commission to consider an allocation in the 3.4 - 3.7 GHz band, which has been designated for FWA services in many different countries, including CITEL for the Americas,^{13/} and is currently being proposed by Industry Canada.^{14/}

As Nortel has previously explained, an FWA allocation would well serve the public interest.^{15/} An allocation for wireline-equivalent FWA will enable new and existing carriers to provide: (i) the ability to meet universal service needs in a rapid and more economical

^{12/} Nortel is aware that many wireless operators (including cellular, PCS and satellite) plan to address some of the market sectors to be served by FWA. Indeed, Nortel is actively involved in the deployment of many of these various wireless networks. In evaluating many of these different markets and networks, Nortel has learned that many wireline operators expect the PCS and satellite technologies to play some role in attracting some customers away from the regulated wireline services. Nortel believes, however, that PCS and the other wireless networks are unable to satisfy the full market requirements of wireline equivalent capacity, quality, reliability and transparency of services.

^{13/} See CITEL RECOMMENDATION PCC-III/REC.26 (VI-96) approved in Acapulco in December 1996.

^{14/} Canada Gazette Document DGTP-006-97 (August 1997) "Spectrum Management Proposals to Provide New Opportunities for the Use of the Radio Spectrum in the 1-20 GHz Frequency Range."

^{15/} See generally, Nortel Comments in RM-8837, filed August 12, 1996.

manner; (ii) the ability to share wireless infrastructure and investments with other wireless services/operators, thereby reducing everyone's unit costs, avoiding the perpetuation of less economic fiber and copper infrastructures; (iii) a rapidly deployable, cost-competitive alternative facilities-based source of wireline service; (iv) seamless interconnectivity with existing fixed network infrastructures; and (v) new and/or improved dialtone service in areas where service is not now provided at a quality equivalent to wireline offerings in urban areas. These benefits were explained in more detail in previous submissions.^{16/}

III. NORTEL OFFERS ITS ASSISTANCE IN THE ECONOMIC MODELING PROCESS

Economic modeling of the scope and complexity of the universal service models at issue in this proceeding is not an area of expertise for Nortel. However, Nortel has developed business engineering models that it uses with carriers for purposes of deploying both CMRS and Non-CMRS Fixed Wireless Access systems. Nortel has already communicated to the proponents of the Hatfield and BCPM models its willingness to share Nortel's wireless engineering models with them for purposes of this proceeding. Nortel has also expressed a willingness to share its knowledge derived from first-hand experience in deploying FWA systems.

^{16/} See generally, David Trinkwon, "Technology of fixed wireless access," *Telecommunications Policy*, Vol. 21, No. 5, pages 437-450, June 1997.

IV. CONCLUSION

The mainstream availability of FWA technology (and spectrum) will bring numerous direct and indirect benefits to individuals and businesses throughout the United States, as well as improving universal service and reducing its costs. For all of these reasons, the Commission should incorporate FWA technologies into the universal service model(s), and equally important, the Commission should address the spectrum issues identified above so that these benefits can be fully realized in practice, and in a timely manner.

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ATTACHMENT A

Following is a summary of the costs related to the provision of typical Fixed Wireless Access (FWA) solutions. The *major variables* are the number of Radio Base Stations (RBS) required to provide the desired coverage, reliability and capacity for any geographic service area and the cost of any new tower or Base Station site construction, which can vary between \$10k and \$150k per site, depending on the scope for sharing and/or re-using existing buildings, structure or towers.

Normal RF is based on coverage plan economics that assumes coverage of some percentage of subscriber locations within the planned area. The aim is to give the appropriate response to the customer during the initial contact (*e.g.*, a five minute telephone request for service), and an installation appointment within 24 hours for many locations and a provisional installation within one week for the remaining locations. This philosophy is different than that used when planning for mobile coverage, where contiguous coverage is often required and there is no guarantee of service availability or performance at any specific location.

CUSTOMER EQUIPMENT COSTS

For CMRS based FWA solutions, the Customer Equipment can either be a CMRS handset, or special CMRS Line Access Unit (LAU) or fixed telephone with various feature and powering options. Costs can typically be between \$100 and \$600, often with a mixture of customer and operator financing.

For non-CMRS FWA solutions, the Customer Equipment is usually an externally mounted antenna unit plus an internal AC power supply with battery backup options. Service is delivered to standard RJ-11 type jacks or standard internal wiring, with the customer providing standard wireline telephones, fax machines, modems and other accessories. The cost of the network equipment varies between \$1000 per line (for single line delivery) and \$300 per line (for multi-line delivery). In many cases, multiline units can be used to serve more than one customer (via standard copper drops) or the units can be mounted on shared utility poles (with shared AC power) to feed drops to several nearby customers.

Installation times at the customer premises range from "zero" for customer-installed CMRS terminals to approximately 3-4 person-hours for CMRS LAUs or non-CMRS fixed units and the associated power/extension wiring. FWA operators have experienced that the more expensive operator installation process is often cheaper in the long run than "free" customer installation, because of the recurring cost of service calls and visits if the performance and quality of service is impaired by improper installation.

BASE STATION SITE COSTS

The antenna, feeders and incremental (UPS) power at a Base Station site typically amounts to less than \$10-15k plus 3 person days of installation by qualified riggers. The actual pad, tower, civil and environmental (power, air conditioning, etc.) costs for a Base Station site (plus acquisition, right-of-way and annual charges) vary tremendously, from almost zero (for Base Stations on a CO roof) to more than \$150k for isolated or new sites with guyed towers, fences and self-contained cabins, etc.

The number of Base Stations needed to cover a particular geographic area is the single largest variable affecting the overall cost per line/cost per subscriber, and depends on the terrain, plus the amount of spectrum available to serve the projected coverage area for the desired capacity and reliability parameters. Large capacity, large radius coverage areas provide the most economic solution.

Sharing the site costs (and associated feeder/backhaul links) with other services or operators (*e.g.*, MMDS, PCS, LMDS or private radio services) is a major opportunity for lower density suburban and rural communities, and might qualify for municipal infrastructure grants or otherwise reduce the needed Universal Service support. Additionally, if an operator provides the sites and feeder links, then this is also a separate "wholesaling" opportunity to other service providers and wireless network operators.

BASE STATION EQUIPMENT COSTS

Radio Base Station (RBS) equipment typically includes the antenna, feeder and (optional) power items mentioned above, plus a Masthead Unit and radio equipment shelf/cabinet, with plug-in modules and the relevant software. Several configurations and capacities are available in both CMRS and non-CMRS technologies, and detailed engineering estimates are needed to determine the actual equipment configuration and costs at each site. Sites can usually be equipped initially with a minimum capacity radio configuration using an omni-directional antenna (to minimize the cost per

customer covered) and then upgraded incrementally to add more capacity (including through the use of sectored antennas) as customer demands materialize and grow.

<u>Sample Configuration</u>	<u>Max ABH ccs @ P.01</u>	<u>Typical Price</u>
3-bearer omni	680	\$100,000
6-bearer omni	1650	\$150,000
12-bearer bi-sector	3300	\$250,000
18-bearer tri-sector	4970	\$355,000

Multi-year cost/price reductions potentially also could be negotiated as part of an overall volume supply agreement and long term purchasing commitments.

Typical Base Station installation and commissioning time is estimated at 5-15 person days, depending on configuration, assuming that all site, power and feeder/switch/OA&M interfaces are in place and operational.

Where CMRS FWA is used as an incremental offering to a mobility service (or as a hybrid fixed/mobile service offering), then the incremental cost of providing additional Base Station equipment/capacity would need to be factored in to any Universal Service calculations, but should be significantly cheaper than dedicated FWA infrastructure (albeit with a less robust service). FWA capacity does not need to allow for hand-off and roaming overheads, and again would be cheaper than for a mobile service.

FEEDER COSTS

These would be standard DS-1 backhaul links carried by direct copper, fiber or microwave radio as appropriate for the operator, terrain and distances involved. FWA systems are usually optimized to convey concentrated and/or compressed traffic over 2-10 DS-1 backhaul links. Non-concentrated backhaul interfaces would require much larger numbers of DS-1 links and/or limit the number of customer lines per Base Station. Again, where hybrid fixed/mobile or other wireless services are located at a Base Station site, then it will often be possible to share/reduce overall backhaul costs because of the larger traffic volumes.

DS-1 backhaul links which connect into SONET rings present a different cost structure/model than those which are carried directly back to conventional cross-connect or CO frames. In fact, the typical 10-20 mile coverage radius of many FWA

solutions means that customers do NOT have to be hauled back to the nearest (or traditional) CO or cross-connect location. Because the line card and battery feed are now located at (or near) each customer location and the traffic is usually concentrated over the air interface, it is often more economic to haul the Base Station traffic to a more distant/larger/cheaper cross-connect or CO, with scope for switch rationalization and savings, plus reductions in the associated buildings, facilities and maintenance/support costs.

Technically, some FWA Base Stations can separate traffic into bundles going to different (operators') switches, or split Internet traffic onto different links to avoid congestion at the PSTN switch. Other options under consideration/development could also split long distance calls directly to a CLEC or IXC network, while routing local calls to the designated ILEC or CLEC. These capabilities have various regulatory and cost model implications.

CENTRAL OFFICE COSTS

CMRS FWA solutions often share Controller and/or trans-coder equipment to be located at or near the switch location. Other CO costs would depend on whether the FWA was served by a mobile or fixed network switch and associated OA&M systems.

Non-CMRS FWA "Wireline Equivalent" solutions are usually designed or optimized to connect directly into the DS-1 ports of the appropriate fixed network (PSTN) switch.

OTHER COSTS

A range of installation tools and kits plus Element Managers, Radio and Capacity Planning Tools and miscellaneous materials are needed to support a FWA deployment, and their costs should be factored across the planned or actual customer base on an equitable basis.

Spectrum acquisition or leasing/usage costs presumably also need to be allowed for in the cost models, although these should reflect the characteristics of Universal Service coverage areas, densities and economics.

CERTIFICATE OF SERVICE

I, Mary-Helen Dove, do hereby certify that a copy of Comments of Northern Telecom, Inc., dated September 24, 1997, has been served upon the following:

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